

# Discovery of Sound in the Sea

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## LONG-TERM GOALS

This public outreach and education project provides for scientific content additions to the popular *Discovery of Sound in the Sea* (DOSITS) web site as well as for an update and expansion of the widely received educational CD-ROM produced by the project team.

Our top-level goals are as follows:

- Expand the DOSITS web site to include a new section titled “How do we investigate the effects of sound on marine mammals?” Also expand the fish and sound sections.
- Add new advanced science content to the DOSITS web site for upper level physics students and instructors including discussions of wavelength, spectrograms and the analysis of sounds, backscattering, and the SOFAR channel.
- Develop a tri-fold brochure that introduces the public to the issues and science content of DOSITS. It will target a general audience of stakeholders and educators and introduce the DOSITS site as a resource for further information. It will serve as a visual guide to the web site while addressing some popular current misinformation on the effects of sound upon marine mammals.
- Develop a 10-page educational booklet that provides an in depth look at Sound in the Sea and targeted issues for interested stakeholders and the public. This will allow the reader to become familiar with factual scientific information while dispelling commonly held myths. It is intended to include background information on the science of sound, the relationship of sound and water, sound production and reception by people and animals, recent scientific research highlights, and our current state of knowledge on the impacts of sound in the sea upon marine animals.
- Review the Discovery of Sound in the Sea scientific content through review session with leading scientists in the field of marine acoustics. The review sessions will focus on all newly developed materials as well as current material as it relates to emerging research.

## OBJECTIVES

The scientific objective of the DOSITS project is to provide the public, stakeholders, and educators a comprehensive synthesis (from published scientific research) on sound in the sea that includes the science of sound; animal and human sound production, reception, and use; and the technology related

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to the use of sound in the sea. In addition to this scientific content, galleries are included in the DOSITS web site that allow for highlights of current topical research and scientist interviews as well as audio files of many natural and anthropogenic underwater sound.

## **APPROACH**

The University of Rhode Island's (URI) Office of Marine Programs (OMP) and Marine Acoustics Inc. (MAI) are partners in this endeavor. Also a national team of experts serves on the DOSITS advisory team and is involved in all phases of the work. The advisory team is led by Dr. Peter Worcester from Scripps Institution of Oceanography and also includes Dr. Kurt Fristrup from Cornell University, Dr. James Lynch from Woods Hole Oceanographic Institution, Dr. James Miller from the University of Rhode Island, James Locascio from the University of South Florida, and Dr. Peter Scheifele from the University of Connecticut. The system used for the DOSITS scientific content development requires that experts, including Kathleen Vigness Raposa from Marine Acoustics Inc., write the content while the URI education and public outreach team edits it for reaching the target audiences. The scientific advisory team provides technical guidance at all stages and a final review of all content is conducted before the text is published.

Below is the task list agreed upon by the partners:

### **Office of Marine Programs**

- Advanced Scientific Content – provide background content, edit content as necessary, add to the audio gallery as necessary
- Tri-fold Pamphlet and Informational Brochure – provide content and graphics, edit content as necessary; OMP graphic designer will layout pamphlet and brochure, prepare camera ready copy, and interface with printers

### **Marine Acoustics Inc.**

- Advanced Scientific Content - provide background content, edit content as necessary, add to the audio gallery as necessary
- Tri-fold Pamphlet and Informational Brochure – provide content and graphics, edit content as necessary

### **Scientific Advisory Team**

- Advanced Scientific Content - general advisor for all activities, identify content topics targeted for expansion, provide background content, edit content as necessary
- Tri-fold Pamphlet and Informational Brochure – advise on content and graphics, edit content as necessary

To disseminate DOSITS products 5000 CD-ROMS containing the web site, PowerPoint presentations for educators to use in their classrooms, expanded interviews with scientists, and classroom activities are provided free of charge throughout the year at several national venues. DOSITS staff gave presentations at annual AGU, NSTA, NMEA, ASLO, and the Marine Mammal conferences. During this cycle of DOSITS the tri-fold brochure and 10-page booklet will also be widely disseminated.

In response to the demand from physics instructors and in conference with the DOSITS scientific advisory team, additional advanced science content sections include:

A. Wavelength - One specific topic that is not really treated adequately in the current web site is the concept of wavelength, which is critical in discussions of scattering (both forward and back scattering) and resonance.

B. Fish – The DOSITS fish sections in Animals and Sound in the Sea and the Audio Gallery need to be further developed and made compatible with the level of detail in the marine mammal sections

C. Spectrograms and the Analysis of Sounds - It is important to understand why specific equipment, signals, etc. are chosen for specific tasks. For example, why is a chirp sonar selected to examine the seafloor, why does a submarine use different signals than a diver, why do different marine mammal species use different sound signals, etc. The answers to these questions will lead into an advanced discussion of spectrograms and the analysis of sounds.

D. Backscattering – An advanced topic on backscattering will provide the technical details behind questions such as, how is backscattering used to identify objects, provide high-resolution images of the underwater world, measure currents, etc.

E. SOFAR Channel – This is perhaps one of the most misunderstood phenomena by students and educators alike. An advanced content section will include how it develops, how different frequencies travel in it, and the mathematics behind the processes.

F. The History of Underwater Sound Exploration – This section will include the discoveries and scientific process that founded the field of underwater acoustics.

The scientific content in DOSITS addresses many topics and provides critical background information for the general public, stakeholders, educators, and students. Scientific literacy is essential for understanding many controversial issues surrounding sound and its production and reception in the sea. The DOSITS team is producing two valuable public relations publications that will further enhance understanding of sound in the sea.

The first is a tri-fold brochure that will introduce the public to the issues and science content of DOSITS. This brochure will target a general audience of stakeholders and educators and introduce the DOSITS site as a resource for further information. It will serve as a visual guide to the web site while addressing some popular current misinformation on the effects of sound upon marine mammals.

The second publication is a 10-page educational booklet that provides an in-depth look at Sound in the Sea and targeted issues for interested stakeholders and the public. It allows the reader to become familiar with factual scientific information while dispelling commonly held myths. It is intended to include background information on the science of sound, the relationship of sound and water, sound production and reception by people and animals, recent scientific research highlights, and our current state of knowledge on the impacts of sound in the sea upon marine animals.

## **WORK COMPLETED**

Thus far a formal review session has been held to review newly developed content for the DOSITS web site. During this session the scientific advisory team worked with the DOSITS staff to develop outlines for the tri-fold brochure and the educational booklet. Preliminary content for both of these publications has been developed.

A thorough review of all sections related to fish and sound has been completed by James Locascio and is currently being adapted for the target audiences. All new content that has been approved by the scientific advisory team has been uploaded to the DOSITS web site.

Another review session has been planned for May 2006 to review the final copy for the brochure and booklet. At this time new advanced science topics will also be reviewed.

Educational activities related to DOSITS have been developed and added to the DOSITS CD. These activities have been pilot tested using audiences at the 2005 NSTA and NMEA conferences. A formal poster has been prepared for the 2005 Marine Mammal conference.

## **RESULTS**

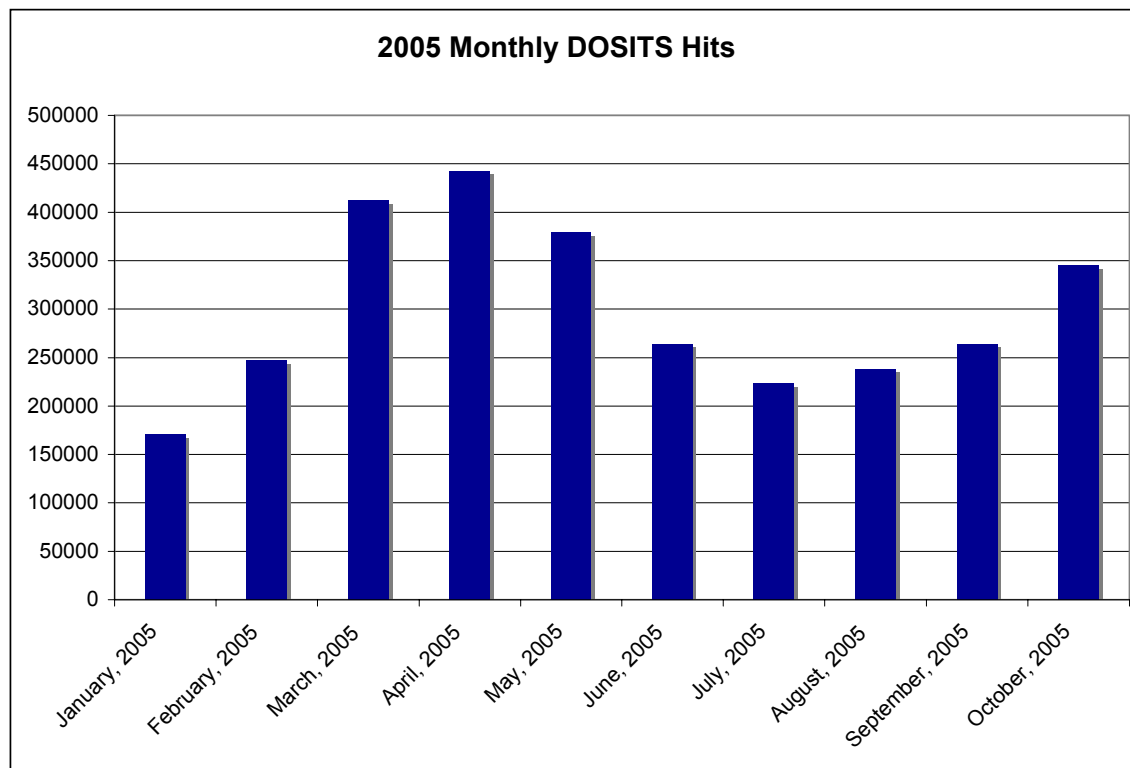
The DOSITS site was launched in November 2002. DOSITS is hosted on the Office of Marine Programs Web server located on the University of Rhode Island Bay Campus at the Graduate School of Oceanography on an Apple G4 server running Apache under OS X. The site and associated education materials continue to be useful resources for a variety of audiences. The partnership between scientists and education professionals has been beneficial in developing one of the most heavily visited ocean science web sites.

The DOSITS site has had approximately 3 million hits from January 2005 through October 2005. Since the launch of the DOSITS web site there have been approximately 7.5 million hits. This far in 2005 the traffic on the web site has increased over previous years. OMP has worked to increase the exposure of DOSITS by having a stronger presence at additional meetings such as the National Marine Educator's Meeting and giving a CD to every National Ocean Sciences Bowl coach for the 2005-2006 academic year competition. In addition, 400 CDs will be distributed at the Marine Mammal Conference in December. There have also been multiple requests for the DOSITS CD from the community involved with teacher professional development.

In 2005 the Galleries remained the most popular pages visited and the majority of the traffic went to the Audio Gallery. The Galleries accounted for 36% of the 2005 traffic, growing from 2004. The Animals and Sound section accounted for 21% of the traffic and science was 15%. The glossary accounted for 8.5% followed by Teacher Resources at 7.7% and People and Sound at 6%.

Within the Gallery, marine mammals accounted for 37% of the pages visited, fish 12%, technology 12%, natural sounds 9% and anthropogenic sounds 8%. Within the animals section, how animals produce sound accounted for 31%, how animals use sounds accounted for 29%, effects of sound was 18% and the importance of sound was 7.6%. Within Science, the Sounds in the Sea section was 29% of the traffic, How Sound Moves was 26%, What is Sound was 16%, Measuring Sound was 14% and the advanced topics were 4.5%.

Below is a table of total traffic on the DOSITS web site during 2005. The hits in March to June are typically high due to the strong exposure the site gets at the National Science Teachers Association meeting in March.



The average visitor to DOSITS views 2.3 pages and stays for almost 6 minutes. Visitors spent the most time in the marine mammal section of the Audio Gallery, which is not surprising as they are most likely listening to multiple whale sounds.

The top downloads in 2005 in order were:

- Blue Whale sound
- Wave on a beach sound
- Humpback Whale sound
- Hydrophone activity PDF
- Cup of Sound activity PDF
- Inside the Box activity PDF (elementary)
- Inside the Box activity PDF (Middle & HS)

Each was downloaded more than 1,000 times.

In 2005, at least one third of the traffic on the site is referred from a search engine. Google accounts for about 65% of the search engines, with Yahoo accounting for much of the rest of the traffic. However, entities like AOL, which average around 3-4% of our traffic, cache popular pages and may represent a much greater audience than we are able to record.

There were a large number of words used in search engines that brought up a DOSITS page. The top search word that brought visitors to DOSITS was “sound”, followed by “how”, “sounds” and “animals”. The top search words were not necessarily used together.

For this analysis all traffic from the URI/GSO Coastal Institute was excluded to remove all visits by OMP staff. All known robots and automated programs were also excluded. The traffic recorded by the web server is a minimum as AOL, other ISPs and many corporations cache popular pages. For example, proxy.aol.com is the ISP with the most traffic identified in the log files but many AOL users may not be recorded on our server if they request a file recently viewed by another AOL user. Because it is more art than science to translate hits into information like pages and visits and unique visitors we have presented all the numbers in terms of hits. However we can make a reasonable estimate. DOSITS pages have from 1 to 22 items per page. Therefore pages served are most likely in the range of 250,000 to 450,000 for the year 2005 so far and between 400,000 and 1,000,000 for the life of DOSITS. Additionally, many more people probably use DOISTS on a daily basis from the CDs (over 10,000 now distributed) and never connect to our server.

## **IMPACT/APPLICATIONS**

The DOSITS project is working to dispel many popular myths about sound in the sea and impacts of anthropogenic induced sound on marine life. The heavy traffic on the web site is an indication of public interest in these topics. The printed materials currently in development will further the goals of the DOSITS team. These new materials will be available to legislators and policy makers, stakeholders, NGOs, etc.

DOSITS is meeting a need in the science education community for topical current science and associated educational activities related to real world events. The DOSITS projects helps educators to meet national science education standards. The DOSITS team has been responsive to the needs of physics instructors for advanced science content ensuring that physical science concepts may be taught using the properties of sound in the sea as the examples.

## **TRANSITIONS**

This is not applicable to DOSITS.

## **PUBLICATIONS**

<http://www.dosits.org>